

Small Animal Pacemaker

Requirements Capture

Group SD1305

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September 3rd, 2013

Introduction:

The pacemaker is a medical device that is used to regulate the beating of the heart by using electric pulses that are transported from the body of the device to its leads. The leads are attached to the right ventricle and left atrium wall respectively. These electrodes have the ability to sense the electric signal from the connected area; if the pacemaker detects an inadequate signal, correct pacing voltage will be applied. There is a nomenclature used to define the type of pacemaker called the “Three Letter Pacemaker Designation.” The first letter designates the chamber that is being paced: A for atrium, V for ventricle, and D for both. The second letter designates the chamber that is being sensed: A for atrium, V for ventricle, D for both, and O for none. The third designates the type of pacing: T for trigger mode, I for inhibit mode, D for both, and O for none. Trigger mode is defined by a device that always paces, while inhibit mode paces only when the pace is needed. The animals that this device will be implanted into are called knockout mice. These knockout mice are genetically engineered to have a gene altered with one that causes heart disease. The pacemaker would control the heart and act as cardiovascular research device. Figure 1 shows an overview of the heart. Note that the right atrium and the right ventricle will be the areas where the leads would be located.

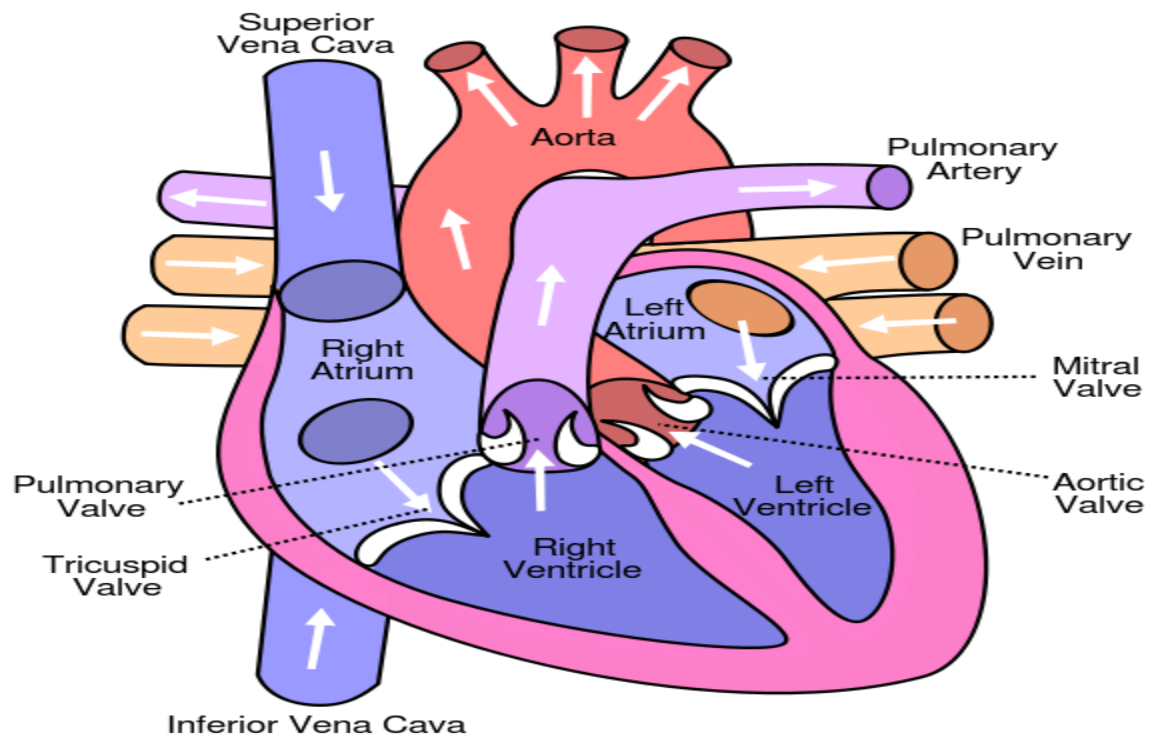


Figure 1 Overview of a Human Heart.

Source:(http://upload.wikimedia.org/wikipedia/commons/thumb/e/e5/Diagram_of_the_human_heart_%28cropped%29.svg/600px-Diagram_of_the_human_heart_%28cropped%29.svg.png)

Requirements:

1. DDD type pacemaker targeted to be small enough to implant within a rat or mouse
2. Working budget of \$200
3. Target outer diameter of 7 mm
4. Target length of 11 mm
5. Target volume of 0.5 mL
6. Battery operated
7. Target 4-8 week battery life
8. Two unipolar electrode leads capable of pacing the heart's atrium and ventricle
9. Pace at a rate necessary to capture mouse heart (700-900 bpm)
10. Set pacing threshold (0.5 V - 2 V), operate at this pacing rate
11. Preference will be given to biocompatible material
12. Benchtop demonstration of pacing capability
13. If time allows, acute animal experiment to demonstrate pacing capture

Summary:

Overall, the goal of this device will be to pace at the heart rate of a mouse that has been genetically engineered to have heart complications for research purposes. The device will ideally be roughly the size of a gel cap to be implanted in a mouse or rat. When implemented, the device will be able to pace both the atrium and ventricle, but will not be required to sense both the atrium and ventricle nor work in both trigger and inhibit mode. Because this device will be primarily used for research purposes, it will not need to last the life span of the patient.

This document describes all project requirements set forth by our design team, Dr. Ewert, and Dr. Greg Shearer. Grading will be performed at the end of the semester according to the level at which these requirements are met.